

Assignment: Homework 0

This assignment is designed to help you review some Matlab basics. You do not have to submit your solutions, and they will not be graded.

1. Use Matlab as a calculator to find out answers of

$$\sqrt[2]{4^5}, \quad (3 + 4i)(5 - 6i), \quad \sqrt[2]{5}e^{i\pi/4}$$

2. Matrix operations. Let

$$A = [-7 \ 5 \ -9; \ 2 \ -1 \ 2; \ 1 \ -1 \ 2];$$

$$B = [16 \ 3 \ 2 \ 13; \ 5 \ 10 \ 11 \ 8; \ 9 \ 6 \ 7 \ 12; \ 4 \ 15 \ 14 \ 1];$$

$$C = [4 \ 2 \ -3; \ 7 \ -7 \ 9; \ 3 \ -5 \ 6];$$

$$D = [6 \ 3 \ 2; \ 2 \ 12 \ -7; \ -1 \ 6 \ 2; \ -5 \ 15 \ 11];$$

Calculate: $3A-5C$, BD , CD'

What is the difference between $A*C$ and $A.*C$?

What is the difference between $[A, C]$ and $[A; C]$?

3. Use *help* to find what these commands are

abs, *angle*, *exp*, *mean*, *var*

4. Plot the expression

$$p(t) = 5 * 2^t, \quad \text{where } t = 1:100.$$

5. Plot the following signal (a sum of two sine waves) for $t=0:0.001:1$ (i.e., 0 to 1 seconds with a step size of 1 ms).

$$S(t) = 0.7*\sin(2*\pi*100*t) + \sin(2*\pi*150*t)$$

6. Use a *for* loop to create a noise signal by adding 1000 sine waves with random frequencies between 20 and 20,000 Hz. Random number generator function `rand()` will be handy.

Operators and special characters

| | |
|-----------|---------------------------------------|
| + | Plus |
| - | Minus |
| * | Matrix multiplication |
| .* | Element-wise multiplication |
| ^ | Matrix power |
| .^ | Element-wise power |
| \ | Left division |
| / | Right division |
| ./ and .\ | Element-wise division, right and left |
| ' | Transpose |
| .' | Non-conjugate transpose |
| == | Is equal to |
| < | Is smaller than |
| > | Is greater than |
| & | Logical AND |
| | Logical OR |
| ~ | Logical NOT |

Graphs and images

| | |
|----------------------------------|--|
| <i>figure</i> | Make a new window for a graph |
| <i>plot (x1, y1, x2, y2,...)</i> | Draw line graph |
| <i>subplot (n,m,p)</i> | Draw several graphs in one window |
| <i>hold on</i> | Plot another graph in the same picture |
| <i>title</i> | Add title to current axes |
| <i>xlabel</i> | Label x-axis |
| <i>ylabel</i> | Label y-axis |
| <i>legend</i> | Add legend to graph |
| <i>xlim</i> | Specify range of x-axis |
| <i>ylim</i> | Specify range of y-axis |
| <i>imagesc</i> | Display image with scaled colors |
| <i>histogram</i> | Histogram plot |

Conditional statements and loops

if, elseif, else Execute statements if condition is true

Syntax: if expression
 statements
 elseif expression
 statements
 else
 statements
 end

for Execute statements specified number of times

syntax: for index = values
 statements
 end

while Repeat execution of statements while condition is true

Syntax: while expression
 statements
 end

Some Functions

| | |
|--------------------|---|
| <i>audioread</i> | Read audio files |
| <i>audiowrite</i> | Write audio files |
| <i>soundsc</i> | Autoscale and play vector as sound |
| <i>fft</i> | Discrete Fourier transform |
| <i>ifft</i> | Inverse discrete Fourier transform |
| <i>fftshift</i> | Shift zero-frequency component to center of spectrum |
| <i>freqz</i> | Frequency response of digital filter |
| <i>filtfilt</i> | Zero-phase forward and reverse digital IIR filtering |
| <i>fir1</i> | FIR filter design using the window method |
| <i>rectwin</i> | Rectangular window |
| <i>hamming</i> | Hamming window |
| <i>lpc</i> | Linear Prediction Coefficients |
| <i>filter</i> | One-dimensional digital filter |
| <i>spectrogram</i> | Spectrogram using a Short-Time Fourier Transform (STFT) |
| <i>dir</i> | List directory |
| <i>strcat</i> | Concatenate strings |